MORDACIA PRAECOX, N. SP., A NONPARASITIC LAMPREY (PETROMYZONIDAE), FROM NEW SOUTH WALES, AUSTRALIA

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(*Communicated by Professor A. K. O'Gower*)

(Plate XIV)

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Synopsis

The adult of a new species of lamprey, *Mordacia praecox*, from the Moruya and Tuross rivers in southern New South Wales, is described. This species differs from the only other Australian species of *Mordacia*, *M. mordax* (Richardson), by being nonparasitic and having its life cycle entirely restricted to fresh water. It can be distinguished from the recently metamorphosed forms, or macrophthalmia, of *M. mordax* by its colour and dentition, and from the adults of this species by a difference in size.

Introduction

There are two genera of lampreys found in Australia, *Geotria* and *Mordacia*. *Geotria* is represented by the single species, *Geotria australis* Gray, 1851, which is found in Western Australia, South Australia, Victoria and Tasmania (Potter and Strahan, in preparation). *Mordacia mordax* (Richardson, 1846), the type species for *Mordacia* Gray, 1851, has until now been the only known Australian species of this genus. Although anadromous like *G. australis*, it is not as widely distributed, being found only in south-eastern Australia and Tasmania. The ammocoetes of both species metamorphose in the rivers and then feed parasitically at sea before returning to fresh water to breed.

Recently, however, a nonparasitic lamprey has been discovered in the Moruya and Tuross Rivers in southern New South Wales, where *M. mordax* is also found. This is the first example from the Southern Hemisphere of a lamprey with a life cycle entirely restricted to fresh water and lacking a parasitic phase. The adults can be distinguished from those of *M. mordax* by the great difference in length. It is also possible to separate, at any one time, the recently metamorphosed ammocoetes, or macrophthalmia, because metamorphosis of the two species occurs at entirely different times of the year (Potter, in preparation). The ammocoetes of the two species appear indistinguishable and there is no indication that they are found in different regions of the rivers, since at metamorphosis both species are found at all sites studied. The name *Mordacia praecox*, n. sp. is proposed because of the precocious nature of sexual development.

The macrophthalmia of *M. praecox* is very similar to that of *M. mordax* (fig. 1), which has been described by Strahan (1960). The description will therefore only apply to the adults of *M. praecox*, which are obviously different, and which show a marked sexual dimorphism.

Material

As only a few adults of *M. praecox* were caught, macrophthalmia were kept in the laboratory until they reached sexual maturity. Since no differences have been found between the measurements and morphology of these adults and those from the field, both have been used for the description. All measurements and counts were made on animals caught between the middle of April and end of July in the years 1965-67.

Methods

Length Measurements. Length measurements were made on the left side of live animals, after they had been anaesthetised in M.S.-222 (Sandoz), and are expressed as a percentage of the total length in the style of Vladykov (1955).

Total Length (T.L.) : distance from the most anterior tip of the disc to the end of the caudal fin.

Disc Length (d) : distance from the tip of the snout to the posterior edge of the disc when closed.

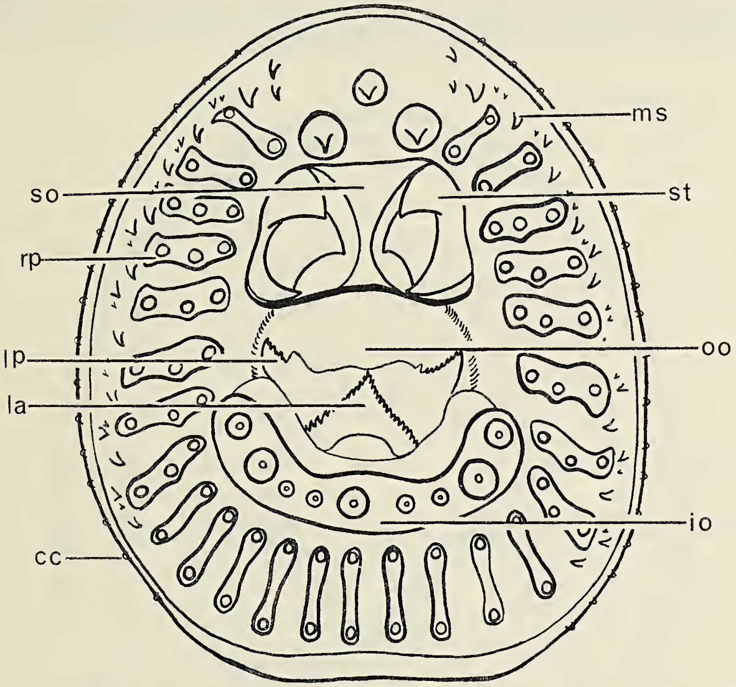

Fig. 1. Schematic drawing of the disc and dentition in the macrophthalmia of *Mordacia mordax.*

Prebranchial Length (d-B_1) : distance from the most anterior edge of the oral disc to the anterior edge of the first gill opening.

Diameter of Eye (o) : horizontal diameter of eye.

Branchial Length (B_1-B_7) : distance from the anterior margin of the first gill opening to the posterior edge of the last (7th) gill opening.

Trunk Length (B_7-a) : distance from the posterior edge of the last (7th) gill opening to the anterior edge of the cloacal slit.

Position of Anterior Dorsal Fin (P.ad.) : point at which the anterior dorsal fin starts.

Length of Anterior Dorsal Fin (L.ad.) : horizontal length of anterior dorsal fin along body.

Position of Posterior Dorsal Fin (P.pd.) : point at which the posterior dorsal fin starts.

Length of Posterior Dorsal Fin (L.pd.) : horizontal length of posterior dorsal fin along body.

Tail Length (a-c) : distance from the anterior edge of the cloacal slit to the extremity of the caudal fin (see below).

Height of First Dorsal Fin ($h.D_1$) : maximum height (see below).

Height of Second Dorsal Fin ($h.D_2$) : maximum height (see below).

Vladykov (1955) measured the tail length from the posterior edge of the cloacal slit. However, as this edge is not always clearly visible in *M. praecox* the better defined anterior edge was taken (see also Hubbs and Trautman, 1937).

Since the measurements taken for the two dorsal fins were made on live specimens it was more convenient to measure the vertical distance from the body to the highest point of the fin. This differs slightly from Vladykov, who measured the length of the longest fin ray.

Myomere Counts. The trunk myomeres, on the left side of thirty formalin-preserved specimens, were counted between the posterior edge of the last gill opening and the anterior edge of the cloacal slit. The first myomere counted was the one whose posterior septum passes distinctly and entirely behind the groove, which surrounds the margin of the last gill opening (Hubbs and Trautman, 1937). The last myomere counted by Hubbs and Trautman was the one whose lower posterior angle lies in part, or wholly, above the cloacal slit but, as the myotomal septa of *M. praecox* converge in this region and do not extend completely down to the cloaca, it was not possible to establish the myomere whose posterior angle lies exactly above the cloacal slit (Plate XIV). To determine the last myomere, a vertical line was extended up to the mid-axis of the body and the myomere at this point was marked. The myomere immediately anterior to this one was the last one recorded for the trunk number.

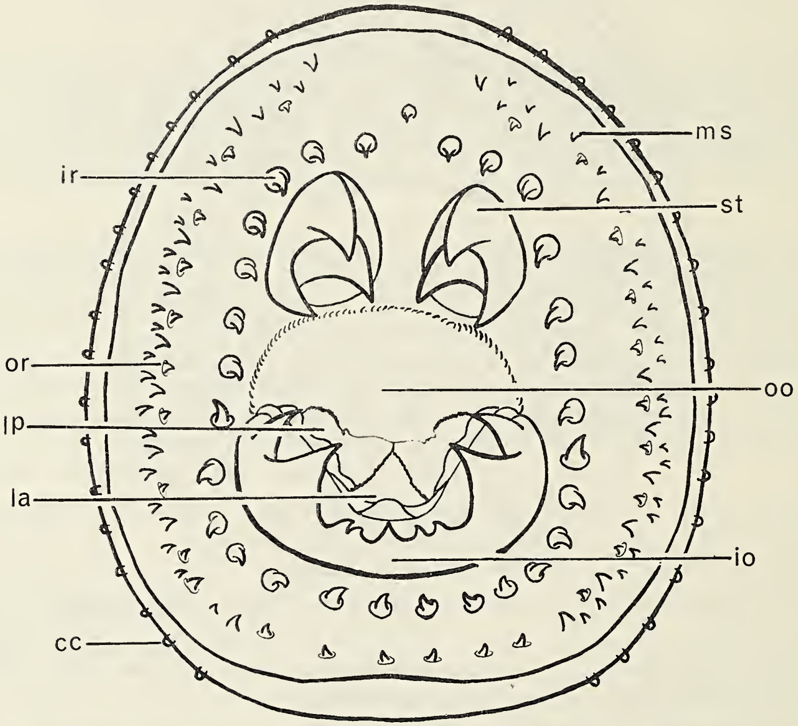

Fig. 2. Schematic drawing of the disc and dentition in the adult of *Mordacia praecox*, n. sp.

Cirri Counts. Small conical cirri are found around the perimeter of the oral disc, except for along a small anterior and posterior region (fig. 2). Counts of these cirri were made, under a dissecting microscope, on twenty preserved specimens.

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prebranchial and disc length ratios of most of the males kept in the laboratory during August and September were greater than the maximum value shown in Table I. However, these have not been included in the description since animals were not obtained in the field after July.

Myomere Counts. The average number of trunk myomeres was 89·7 (Range 85-92, S.D.=1·75, N=30).

Cirri Counts. The conical cirri surrounding the oral disc become more prominent during the final stages of sexual development and the average number found in this region was 39·6 (Range 36-45, S.D.=2·68, N=20).

Dentition (Fig. 2). As the dentition of *Mordacia* differs from that of other lampreys, and also undergoes considerable changes during the life cycle of the animal, some alterations in the terminology generally used in taxonomic descriptions, have been necessary.

The marginal series consists of scattered lateral teeth, two or three deep, situated just inside the rim of the oral disc. The radial series, which lie within the marginals, comprise twenty-six pairs of teeth, which are formed by the breakdown of the middle part of radial plates present in the macrophthalmia. Both the outer and the inner teeth of the radially-arranged pairs each form a circle, which is continuous, except at the anterior part of the disc where there are three teeth arranged in the form of a triangle. There were twenty-seven and thirty pairs of teeth, instead of the normal twenty-six, in two of the ten specimens examined, but their dentition was normal in all other respects.

There are two separate supraoral tricuspid tooth plates, which, in the macrophthalmia, are joined by a thin plate. The only specimen which did not have supraoral teeth conforming to this pattern had an extra cusp between the two posterior cusps on each plate.

Typically the infraoral lamina bears nine cusps, arranged in two symmetrical groups of four on either side of a median cusp. Beginning with the cusp adjacent to the median one the series of four on the right is designated R_1 to R_4, and on the left L_1 to L_4. Cusps 1 and 2 are the same size and slightly smaller than the median cusp. Cusps 3 and 4 are larger than the median cusp, cusp 3 being the largest on the lamina.

It is only in the region of cusps 1 and 2 that supernumerary teeth have been found. Out of twenty-one specimens twelve contained at least one extra cusp, which was generally smaller than any of the others. In most cases it was clear that these were derived from the same base as either cusp 1 or 2.

The transverse lingual lamina has a V-shaped ridge bearing a row of very small cusps. The terminal cusp of each arm is the largest and the one at the apex of the V is smaller but slightly larger than the others, which are all of approximately the same size. There is a minute row of two or three cusps at rightangles to the main row, but in the same plane, which lie just below the large terminal cusp at each end of the V-shaped ridge. When the piston is projected forwards the transverse lingual lamina appears triangular (fig. 2).

On either side of the longitudinal lingual lamina are two prominences, with serrated edges, whose anterior edge is inclined downwards in attached animals (fig. 2) but upwards in preserved specimens.

Morphology. Both sexes have very dark blue dorsal surfaces, occasionally with a green tinge, but a marked difference exists in the colouration of the ventral area between the last gill slit and the cloaca. In the male this is mottled grey, but in the female the presence of eggs, which can be clearly seen through the body wall, gives this region a yellow appearance. The liver can only be clearly seen in the female and appears as a dark structure at the anterior end of the body cavity. The ventral surface below the gills has a reddish colouration which is more conspicuous in females.

There is greater growth of the tissue surrounding the oral disc of males, but in both sexes this area is of the same colour as the dorsal surface of the body.

Lateral Line System (Fig. 3). The external structures of the lateral line system, like the conical cirri, become more obvious in mature forms and can be seen as a series of papillae, which form a characteristic pattern under the eye and along the dorsal surface of the snout.

Eyes (Fig. 3). As in *M. mordax* the eyes are located dorsolaterally, rather than laterally as in all other genera.

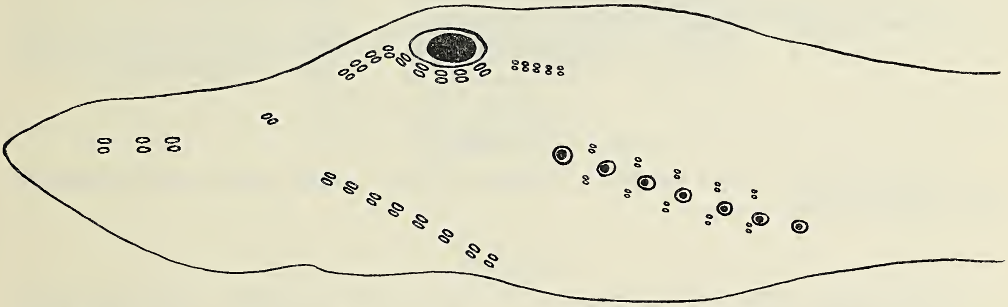

Fig. 3. Schematic drawing showing the arrangement of lateral line organs on the head region of *Mordacia praecox*, n. sp.

Fins (Plate XIV, Fig. 2). There are two dorsal fins, the second being separated by no more than a notch from the caudal fin. The base of each of the dorsal fins, and much of the dorsal region of the caudal fin, is dark blue and small patches of similar pigmentation can also occur throughout both dorsal fins.

Cloaca (Plate XIV, Fig. 1). The cloaca is located beneath the second dorsal fin. A cloacal papilla has not been found in any males but this may be due to the fact that none of these forms were fully mature, even though histological examination showed the testes were in an advanced state of development.

DISCUSSION

Although the great difference in size between the adults of *M. praecox*, 102-172 mm., and *M. mordax*, 300-420 mm., at the commencement of their spawning run (Potter and Strahan, in preparation) enables the species to be easily recognised at this stage of development, the adults of *M. praecox* and the macrophthalmia of *M. mordax* could be confused because of their similar size. The diagnosis will, therefore, contain a comparison of the adult of *M. praecox* with the macrophthalmia of *M. mordax*.

The macrophthalmia of both species are very similar, but it has always been possible to separate these forms in the Moruya and Tuross Rivers because of the different times of metamorphosis. The macrophthalmia of *M. praecox* metamorphoses in October to November and breakdown of the radial teeth plates is just starting at the time that *M. mordax* begins transforming in March of the following year. By April, sexual dimorphism is becoming apparent.

It has not been possible to study the dentition of the macrophthalmia of *M. praecox* in as great detail as that of *M. mordax*, but as far as can be seen they are very similar. This is not surprising since it is generally believed that non-parasitic lampreys have evolved from parasitic forms (Hubbs, 1925 ; Zanandrea, 1961), and thus it is probable that *M. praecox* has evolved from *M. mordax*.

DIAGNOSIS

Adult *M. praecox* can be most easily distinguished from the macrophthalmia of *M. mordax* on the following characters.

Character	*Adult* M. praecox	*Macrophthalmia of* M. mordax
1. *Colouration*		
Dorsal surface	Dark blue	Brownish grey
Ventral surface	Mottled grey in males. Yellow in females.	Silver in both sexes.
2. *Dentition*		
Radial teeth	Consist of an outer and inner row of teeth that are not joined by radial plates.	Teeth are borne on radially arranged plates.
Infraoral lamina	Cusps on lamina are large and point in towards the oesophageal opening.	Cusps on lamina are short and do not point directly in towards the oesophageal opening.

LOCALITY

Moruya River (type locality). Tuross River. Both rivers are in southern New South Wales.

TYPES

The *holotype* (IB.7936) a male of 147 mm., in total length, when measured alive under anaesthetic on 20/7/67 weighed 3·20 gms., and is deposited in the Australian Museum, Sydney. Its proportional measurements expressed as percentages of the total length are as follows : disc length, 8·2 : prebranchial length, 12·6 : eye diameter, 1·4 : branchial length, 8·8 : trunk length, 61·9 : position of anterior dorsal fin, 58·5 : length of anterior dorsal fin, 7·8 : position of posterior dorsal fin, 72·8 : length of posterior dorsal fin, 17·0 : tail length, 17·0 : height of anterior dorsal fin, 1·7 : height of posterior dorsal fin, 2·4. There are 91 trunk myomeres. It was impossible to obtain a completely accurate count of the conical cirri, without damaging the specimen, as the edges of the oral disc have become involuted, but it appeared to have thirty-eight.

An *allotype* (IB.7937) a female of 129 mm., was also measured on 20/7/67 and placed with the holotype in the collection of the Australian Museum. It differs from the holotype in having a proportionally shorter prebranchial (10·4) and disc (5·8) region, and by having eggs visible through the body wall, which gives the ventral surface a yellow appearance.

Acknowledgements

I am indebted to Mr. R. S. Strahan, Director of Taronga Zoological Park, for help and encouragement throughout this study. I would like to thank members of the Zoology Department, University of New South Wales, who have assisted in the collection of specimens and given advice during the preparation of this manuscript. I am most grateful to Mr. G. Harris for the photographs, and to Miss R. McNeill who made the drawings.

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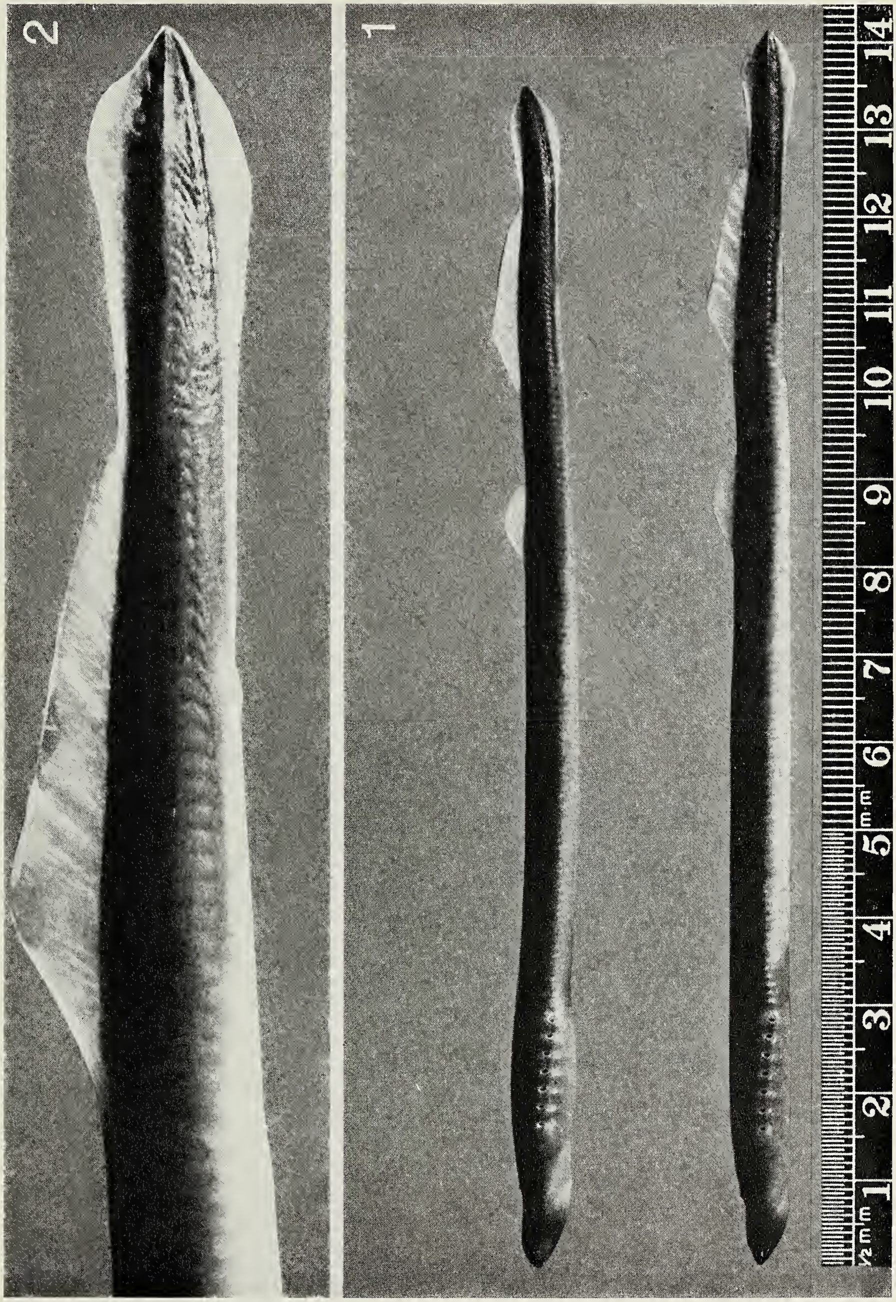
EXPLANATION OF PLATE XIV

1, Male and female of *Mordacia praecox*, n. sp., caught in July 1967 ; 2, Tail region in a female of *Mordacia praecox*, n. sp., showing the posterior and caudal fins, the position of the cloaca and the arrangement of myomeres.

Index to Text Figures

cc — conical cirrus
io — infraoral lamina
ir — inner radial tooth
la — transverse, or anterior, lingual lamina
lp — longitudinal, or posterior, lingual lamina
ms — marginal series tooth
oo — oesophageal opening
or — outer radial tooth
rp — radial plate
so — supraoral lamina
st — supraoral tricuspid tooth



Mordacia praecox, n. sp.